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Can the Survival Processing Effect be Replicated in Non-Ancestral Survival Scenarios?

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Abstract

When primed to think about one's survival, participants experience an increase in recall for a set of words. This result called the 'survival processing effect' was initially found for participants primed to think about their survival in an ancestral environment. The present study was designed to access whether the effect could be replicated in non-ancestral scenarios. Analyses showed that the effect could be replicated and that non-ancestral scenarios even led to a slightly higher level of recall than the traditional ancestral scenario. Various characteristics of the modern scenarios are believed to have been responsible for this finding including an increase in familiarity and fear, as well as a higher degree of media attention. This study helps to broaden the robustness of the original findings on the survival processing effect.

Introduction

While Darwin's theory of evolution generally brings physical characteristics to mind, there have also been adaptations discovered involving cognitive processes, such as those involved in the storage, processing, and retrieval of memory. For example, it has recently been proposed that evolution has tuned our memory systems to perform better at certain times over others. In order to increase our fitness for survival, our memory systems may have evolved to be able to remember more information when there is a perceived threat to our survival. In 2007, a study was conducted by Nairne, Thompson and Pandeirada that supported the hypothesis of a "survival processing memory advantage," based on the idea that information encoded while thinking about survival will be remembered better than information encoded using other effective semantic processing techniques. In the initial study, processing words for their survival value in a particular survival scenario led to the improved retention of a list of words relative to

several other processing techniques. Since this landmark discovery of the survival processing effect, there has been considerable interest in the causes and implications of survival related memory and the robustness of the retention advantage when compared to other scenarios.

In the original experiment on the survival processing effect, participants were asked to imagine that they were "…stranded in the grasslands of a foreign land without any basic survival materials." This scenario was chosen because it is believed that many human adaptations were developed during the Pleistocene era when mankind was living in this type of environment (1.8 million to 10,000 years ago). While some of the follow-up research articles have suggested that scenarios in other environments may invoke the same memory effects as the grasslands scenario, the results are thus far inconclusive (e.g., Soderstom & McCabe, 2011).

In Nairne et al.'s (2007) landmark study, the percentage of words recalled correctly after being primed with the grasslands scenario was compared to recall of the same words when rated for their relevance to a moving scenario, or for their pleasantness value, since both of these tasks are semantic processing tasks and the moving scenario presumably also invokes self-referential thinking and thematic processing similar to the survival scenario. Additionally, the study was replicated with a within-subjects design, such that the same subjects were used for each condition in the experiment, so that differences could not be attributable to individual differences in people. The effect was also replicated with a recognition test instead of recall to generalize the results to other types of memory tests. In a series of follow-up experiments Nairne, Pandeirada, and Thompson (2008) also showed that their survival scenario involving incidental learning led to a higher proportion of correctly recalled words than an intentional memory group. Moreover, they showed that survival processing was superior to groups asked to generate a visual image of each word, as well as to both a self-referential processing group and a group asked to generate

the words from scrambled letters. While these experimenters effectively demonstrated the generality and robustness of the original finding, they offered little explanation for why the effect was occurring.

Nairne and Pandeirada (2008) explored the proximate mechanisms that may be responsible for the evolution of our memory systems. Based on the belief that memory was created in order to prepare for future problems that are related to reproductive fitness, they suggested that thinking about survival may enhance retention by means of raising arousal, interest, or emotion. Since one's life is put at risk in a survival scenario, it might cause the fight or flight response which is known to lead to elevated heart rate, slowed digestion, and a number of other arousal-related responses. Moreover, retention of information is also improved if the information reoccurs and continues to be of importance (Anderson & Schooler, 1991). In our ancestral past we faced more threatening situations than in the present so it would make sense that the people with the highest fitness would be the ones that learned how to retain techniques pertinent to avoiding dangers. Since much of human development occurred during the Pleistocene period, Nairne and Pandeirada expected that ancestral environments similar to those that people were exposed to at that time would be more effective at eliciting the survival processing effect.

Additionally, Nairne and Pandeirada (2008) proposed it is unlikely that one single adaptive module is responsible for the survival processing retention advantage since survival is a broad problem faced by our ancestors, one that is unlikely to have been solved with a single adaptation; instead they believe that survival processing may activate multiple domain-specific modules. In other words, since there are so many different aspects of survival that could potentially be threatened, it would be unlikely for there to be one single module that could

encompass each possible threat. Therefore, it is more likely that specific adaptations were developed in order to improve fitness for specific problems, such that the survival processing effect may encompass multiple adaptations.

Since survival processing elicited better memory than processing conditions that were already known to produce good memory, it was hypothesized that survival processing may involve a combination of these "good memory" processing techniques. In a series of experiments by Burns, Burns and Hwang (2011) the survival processing effect was found when control conditions in which only item-specific processing or only relational processing were utilized. In one experiment, the list of words used for the survival condition contained categorically related items to encourage relational processing. In the next experiment, ad hoc word lists were used since these have been known to encourage item-specific processing of words and not relational processing (Burns & Herbert, 2005). In both cases, the survival processing effect was found. However, the effect was eliminated when the survival condition was tested against conditions that utilized both item-specific and relational processing, such as a group that rated the pleasantness of categorically related words. This series of experiments supported the hypothesis that survival processing encourages both item-specific processing and relational processing which may be because it encourages self-referential thinking, which has been shown to utilize the aforementioned processing types as well (see Burns, Burns & Hwang, 2011).

Klein, Robertson and Delton (2010) took an entirely different approach on the subject, hypothesizing that it isn't the amount in which survival is evoked in the condition that is important but instead the level of future planning that must be incorporated into evaluating the scenario. The experimenters felt that humans have evolved the ability to plan for the future at a level that has offered them a selective advantage over other species. By making complex

judgments regarding our future needs, we are able to make decisions that will allow us to meet needs that are not currently weighing upon us, a skill that makes us better equipped for survival than other species.

In the initial study conducted by Klein et al. (2010), future planning was tested against a past condition and an atemporal condition, both concerning a camping trip. Additionally, there was a survival condition in which participants imagined that they were stranded in the forest. Previously, in the study conducted by Kang et al. (2008), a burglary planning condition did not perform as well as the survival condition. Since the burglary scenario involved extensive planning Klein et al. would have predicted an elimination of the survival processing effect. However, Klein et al. believed that the Kang et al. result was due to one or more of the many other differences between the scenarios in addition to survival. To correct this potential problem, Klein et al. used scenarios that contained nearly identical wording, and participants were also asked to rate how much each scenario was relevant to survival, which allowed the researchers to verify that the survival and future conditions differed in respect to the extent of survival processing.

As the researchers had hypothesized, the planning condition led to better recall than both the past and atemporal conditions. Interestingly, the future condition also outperformed the survival condition. Their explanation for this result was that the planning condition caused participants to think about their future needs while the survival condition caused participants to think about a mixture of immediate needs and future needs, thus resulting in less thought of future needs. Although Klein et al. believed that the survival group would also cause participants to use some degree of future-oriented thought, he felt that the level of planning was the component that was most important. Since the survival group caused participants to use less

planning, it produced only intermediate results. Participants were confined to think about a specific time period where items were either present or not in the non-planning scenarios whereas the planning scenarios allowed for more imaginative thought.

Another field of research that may in some ways be related to survival processing has looked at a phenomenon called mortality salience. This manipulation in which people are either primed with questions causing them to think about death or primed with control (non-death) questions has been linked to memory. Specifically, processing a list of words after a mortality salience manipulation has been shown to lead to an increase in recall in both incidental and intentional learning tasks (Hart & Burns, 2012), despite the fact that the word processing task is entirely unrelated to the mortality salience prime. Although the mechanisms responsible for the increase in recall memory following mortality salience are currently unknown, it is possible that thinking about death activates the same mental processes as thinking about survival. A likely explanation for their connection is that you cannot think about survival without thinking about not surviving which is the same as dying. While the connection between the two phenomena has yet to be fully evaluated, it is worth considering since the scenarios presented in the current experiment may have brought images of death to the participants and therefore may have activated mortality salience. This possible connection will be discussed more fully in the Discussion section.

Weinstein, Bugg and Roediger (2008) wanted to know whether the survival processing findings could be explained by previously discovered basic memory processes, such as an increase in schematic or self-referential processing. The original survival processing effect study by Nairne et al.(2007) showed that survival outperformed a scenario that should have produced presumably equivalent schematic processing (the moving condition), but Weinstein et al. argued

that the two scenarios were not equivalent due to the novelty of the survival scenario. Weinstein created a scenario with almost identical wording to the original scenario, changing only two words; “grasslands” to “city” and “predators” to “attackers.” Lastly, the level of self-referential processing was manipulated by phrasing the scenarios with either “imagine yourself” or “imagine your friend,” the former of which is believed to have a higher level of item-specific processing due to there being more to elaborate when thinking about oneself versus others (e.g., Rogers, Kuiper, & Kirker, 1977).

This experiment produced mixed results for the two basic memory processes studied. First, the grasslands scenario outperformed the city scenario in both 1st and 3rd person versions. However, regarding self-referential processing, in one case the 3rd person version led to higher percentage of recalled words and in one case it led to lower recall. Since the study was performed on students from the University College London, Weinstein et al. (2008) believed that a city scenario would allow the participants to activate relevant schemas for their memories more readily than the average person which should have improved their recall (Bransford & Johnson, 1972). However, the grasslands scenario still produced better recall. Additionally, the researchers commented that a difference in the level of emotional arousal caused by thinking about threats in the grasslands or the city may have been a contributing factor to the results, but were unable to draw a conclusion due to limited research on the effects of fear and emotional arousal on memory.

Since it is possible that there is a link between survival processing and emotional arousal, other studies attempted to determine the extent to which arousal is responsible for the survival processing effect, as well as studying other factors that may be of relevance. In one experiment, researchers used a burglary planning scenario that was presumably high in novelty and

excitement, similarly to the grasslands scenario (Kang et al., 2008). Additionally, there have been multiple popular TV shows and movies that feature people stranded in the wilderness as well as people involved in a burglary, so the researchers felt participants would be highly familiar with both scenarios. However, the burglary scenario produced worse recall and recognition than the grassland scenario. In a follow-up study, participants were shown one of two video clips and asked to rate words based on their relevance to the clip in order to see if the survival processing effect would persist when not referencing the self. Participants were either shown a clip from *Cast Away*, a movie that features survival in a primal scenario or *Inside Man*, a movie that involves a bank heist. Once again, better retention was found for the survival condition.

Soderstrom and McCabe (2011) replicated the grassland/city experiment of Weinstein et al. (2008) with the addition of two extra groups. In one group, identical wording was used as the original grasslands scenario, except the word "predator" was replaced with "zombies" to create a *grasslands-zombies* scenario. The other group, a *city-zombies* scenario was identical in wording to the city group, except for the word "attacker" was replaced with "zombies". Using a purely between-subjects design, both of the zombie scenarios outperformed both the predator and attacker scenarios and no recall differences were found between grasslands-predator and city-attackers scenarios as previously found. One possible explanation for the former result is the possibility that people are able to form more vivid imagery of zombies than of predators or attackers, due to the influx of zombie-related media in recent years. In addition, whereas the idea of a zombie is a basic level concept that readily brings an image to mind, the idea of an attacker or predator could bring many different interpretations to mind. For this reason, it is possible that participants would not form a specific image of a predator or attacker since it is harder to

imagine. Perhaps it was this enhanced visual imagery that produced the higher retention for the zombie scenarios.

The results from the Soderstrom and McCabe (2011) study allow us to infer that there may be a multitude of scenarios and environments that could possibly trigger the survival processing effect since a scenario based on fiction led to better results than the traditional more realistic scenario. Since we have evolved to survive in a multitude of environments under a multitude of different conditions and have been exposed to media representing many imaginative survival-related situations, there are likely to be many variables which may moderate the survival processing effect, as well as socio-cultural aspects that need to be considered. Additionally, the fact that Soderstrom and McCabe's study did not replicate the recall differences between city-attacker and grassland-predator lends me to the belief that there is nothing special about the grasslands scenario that makes it better than any other survival condition.

While there haven't been any experiments to link emotional arousal to the survival processing effect, there have been studies regarding the effects on an increase in arousal on memory (e.g., LaBar & Phelps, 1998). Following participation in an emotionally arousing task, there is an increase in ability to recall information for a short period of time. One possibility for this is that arousal causes an increase in the release of the neurotransmitter dopamine, which modulates the hippocampus, an area in the brain that plays an important role in the consolidation of memory (Wise, 2004). In Wise's experiment, a link was found between release of dopamine and an increase in memory for environmental stimuli that were of motivational importance or linked to a reward. And what better reward is there than a continuation of life? Dopamine has also been shown to have relevance both in expectations and in outcomes of memory, so it may be the perceived risk of a threat and evaluation of further need for the memory that causes an

alteration in dopamine release (Shohamy & Adcock, 2010). While there have been no brain imaging studies to link dopamine to the survival processing effect, it is possible that the increase in emotion and reward associated with survival could help to explain the increase in memory retention.

One area that has been explored in previous research but never linked to the survival processing effect is the differing fear response that is experienced by threats that were more relevant in the past compared to threats that are more relevant in today's society. Some research has supported the notion that people experience more fear toward threats that were more realistic early in development of the species, such as the threat of starvation or attack from predators than from threats more relevant now such as guns, terrorism, car crashes etc. (Seligman, 1971). On the other hand, there is also research that supports the idea that guns and vehicles may produce more realistic threats in our modern society, thus activating an increased response (Fox, Griggs & Mouchlianitis, 2007). Additionally, there may be individual differences that could affect people's reactions toward perceived threats, such as gender, age, and the type of environment in which they were raised.

While the majority of procedures that have elicited the survival processing effect have used the grasslands scenario, the effect may be as strong or even stronger for different scenarios that involve more realistic and frightening threats to people today. While people would experience fear and an elevation in arousal at the idea of being stranded in the grasslands, for many people this threat may have no real-life relevance and has never or rarely been considered as a possibility. Additionally, there are a minimum of examples of grasslands-related survival crises in the media and current news. However, with the dawn of technology, relevant threats have been geared toward guns, crime, infections, terrorism, and the possibility of nuclear warfare.

These threats are constantly discussed in magazines, movies, newspapers and have spawned many major scares over the past decades.

In order to fully understand the survival processing effect and gain a sense of how and why it occurs, it is necessary to first discover the limits of its scope. In the current experiment, the traditional grasslands condition was tested against two more modern conditions that pose more relevant threats to today's society. In these two conditions, participants were to imagine themselves stranded either in a warzone or in an environment after a major terrorist attack, respectively. Since people most likely have thought about scenarios similar to these fairly often, they should be more familiar with imagining these scenarios and should more readily construct the details in their minds. Additionally, these modern scenarios may cause a more dramatic increase in arousal and fear since they have a higher likelihood of being realized in today's society.

Method

Participants

One-hundred and twenty undergraduate students were either paid $6.00 or received credit toward an out-of-class activity requirement for their psychology course for participation. The average age of the participants was 19.58 years and there were 68 males and 52 females. A maximum of five participants were able to participate in the experiment at one time and each time the experimental procedure was administered, all participants were randomly assigned to one of the four conditions tested in the experiment.

Materials and design

A pilot study was conducted in which participants rated 80 concrete nouns for their relevance to each of the three survival scenarios used in the present experiment. Participants in the pilot study were from the MTURK worker pool. The words were rated on an online rating system where participants were paid for their participation. Eleven participants rated the words for their relevance to the grasslands scenario, 13 rated the words for relevance to the warzone scenario and 10 participants rated the words for their relevance to the terrorist attack scenario. On the basis of these ratings 40 words were selected. The 40 items used had approximately the same average rating among the three scenarios (2.891, 2.810, and 2.897 for the grasslands, warzone, and terrorist attack scenarios respectively).

Procedure

Participants were read aloud instructions specific to one of four conditions and asked to go into a cubicle where they would be presented words one at a time on the computer monitor and asked to rate the words based on their relevance to the scenario read. The participants rated the words on a 1-4 scale where 1 is totally irrelevant, 2 is somewhat irrelevant, 3 is somewhat relevant and 4 is totally relevant by pressing the numbers on the keyboard. Each of the words was presented in the center of the screen for 5 seconds before the next word appeared. The order in which the words were presented was random, but remained constant for each of the participants. The participants were unaware that they would be asked to recall the words later.

The scenario read aloud for the grasslands condition used the exact same wording as the survival scenario used in the original study conducted by Nairne et al. (2007):

> In this task, we would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not- it's up to you to decide.

The second scenario described a war zone and was read as follows:

> In this task, we would like you to imagine that you are stranded in a war zone of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from enemies. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not- it's up to you to decide.

The third scenario described a terrorist zone and was read as follows:

> In this task, we would like you to imagine that you are stranded in the city of a foreign land after a major terrorist attack, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from danger. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not- it's up to you to decide.

The fourth condition simply had to rate the words for their pleasantness , with the instructions as follows:

> In this task, we are going to show you a list of words, and we would like you to rate how pleasant or unpleasant each word seems to you. Some of the words may be pleasant to you and others may not be pleasant. It is up to you to decide.

After the participants rated each of the words, they received a packet of papers and were first asked to complete the Positive and Negative Affect Schedule (PANAS), which required participants to rate 20 words that represented emotions and feelings for the extent to which they were feeling them at the present moment on a scale from 1-5 in which 1 was very slightly or not at all and 5 was extremely.

Once all of the participants completed the PANAS, participants were told that they would be recalling the words from the scenario rating task and that they could write the words down in any order. During the recall task, a tape recorded message was played that instructed the participants to draw a line under the last recalled word after each minute passed, allowing me to record the number of words recalled each minute. The recall phase of the study lasted for 7 minutes.

Lastly, the participants filled out a questionnaire which asked for demographic information (age and sex) as well as ratings on their subjective views about the scenarios. Specifically, they were asked how fearful the scenario was, how realistic the scenario was, how relevant the scenario was to today's society, how much the scenario made them imagine death, how much the scenario made them think about the possibility of their own dying, to what extent had they come across this type of scenario in media such as books, movies and news, and to what extent they felt an increase in arousal during the experiment.

Results

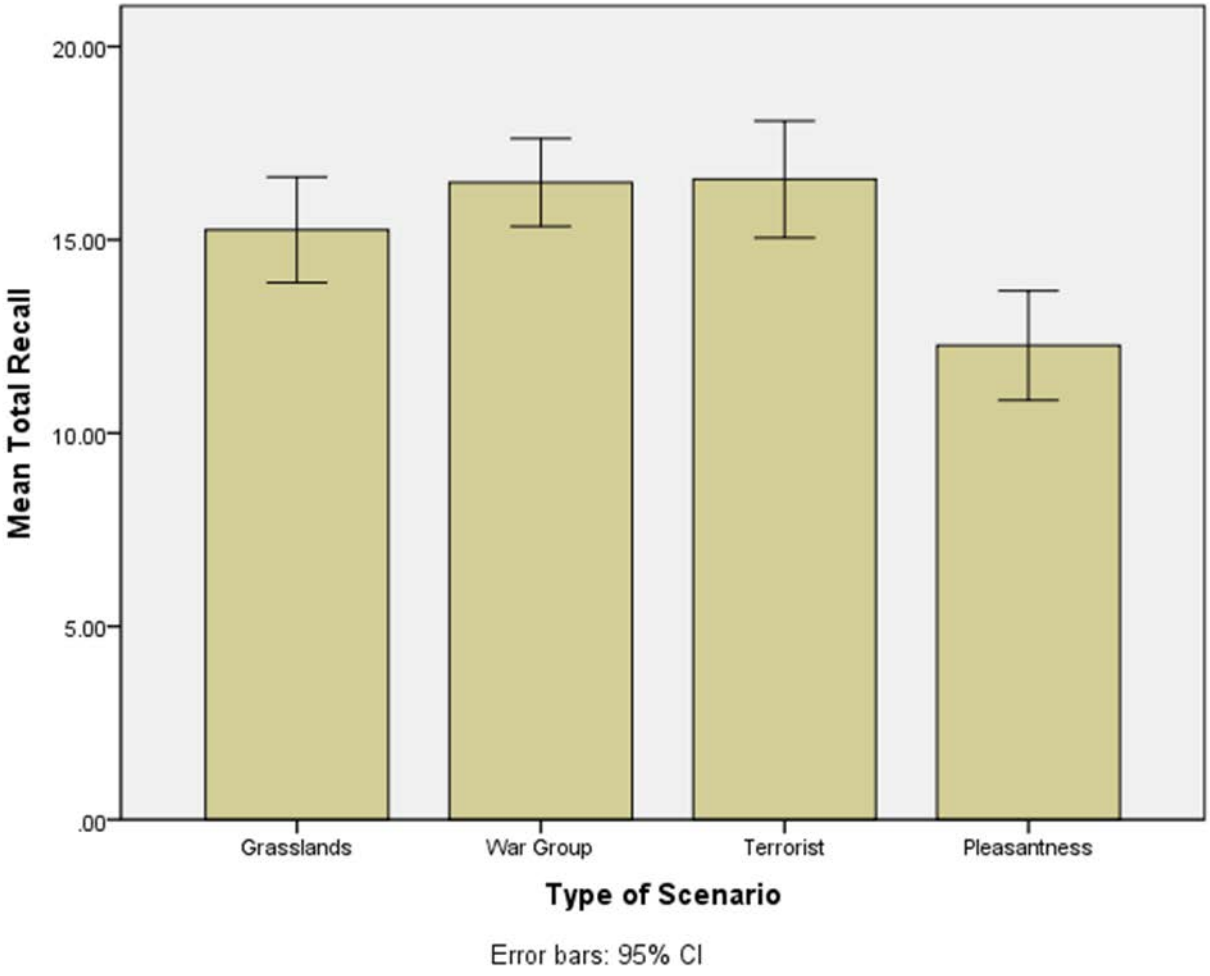

Figure 1. Mean total number of words recalled out of 40 possible words after ranking words for their relevancy to the grasslands, war group, terrorist, and pleasantness scenarios.

The mean number of words recalled for participants in each of the four scenarios is presented in Figure 1. As predicted, the participants recalled more words in the three survival related groups than in the pleasantness group. However, the war group and terrorist attack group both led to numerically higher recall than the grasslands scenario. A one-way between subjects analysis of variance (ANOVA) supported these conclusions, showing that total recall between the four scenarios varied significantly, F (3,116) = 8.98, p = .000. Follow up least significant

difference (LSD) tests revealed that the pleasantness group produced significantly lower recall than any of the other three groups, none of which differed from one another.

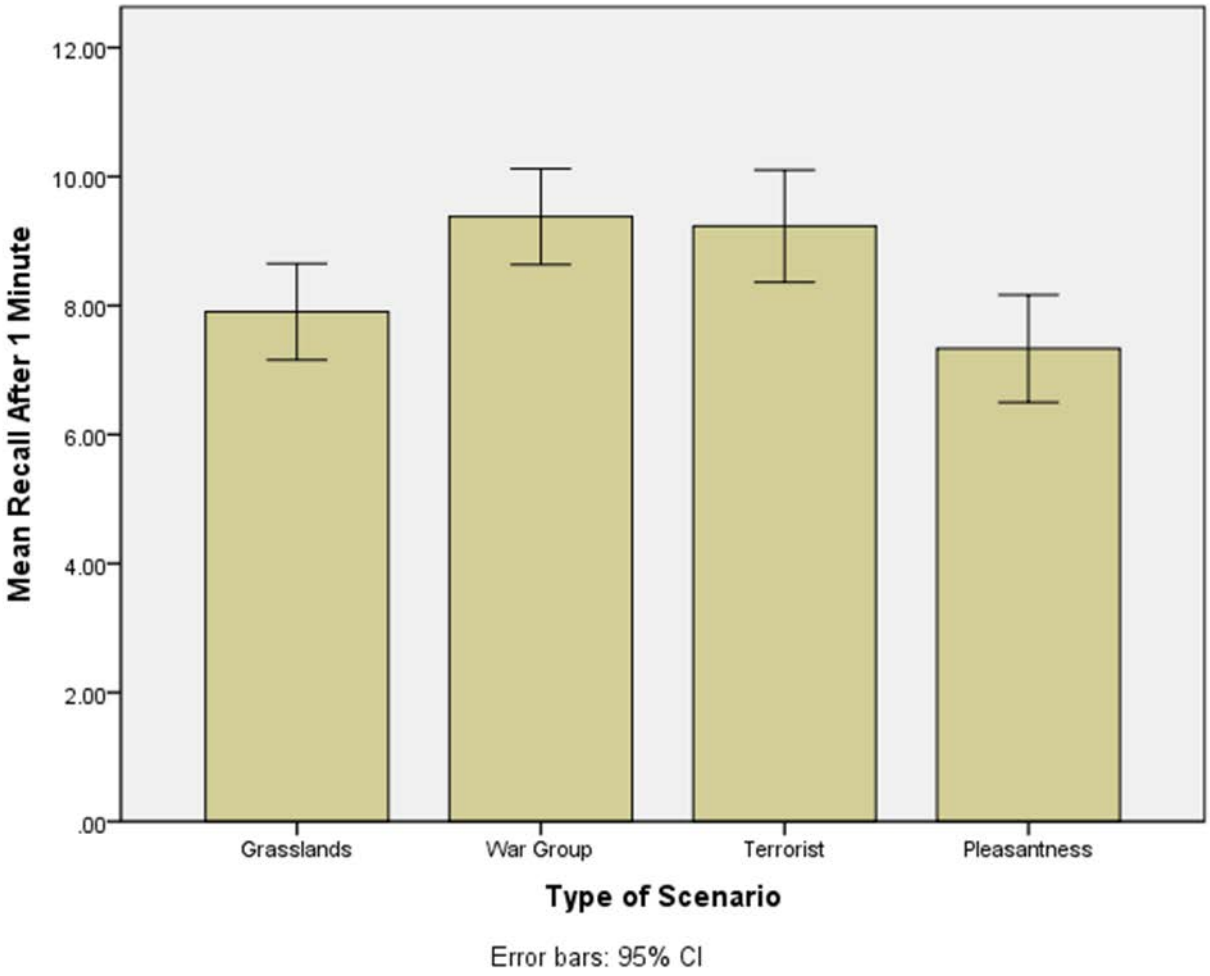

Figure 2. Mean total number of words recalled after the first minute of the recall period after ranking words for their relevancy to the grasslands, war group, terrorist, and pleasantness scenarios.

After evaluating the number of words recalled during each of the seven minutes separately, it was apparent that the first minute of recall differed more than any of the others and this difference was significant as shown in Figure 2, F (3, 116) = 6.53, p = .000. Follow-up LSD tests revealed that both the pleasantness and grasslands scenarios led to lower recall during the first minute than the war group and terrorist groups, which did not differ.

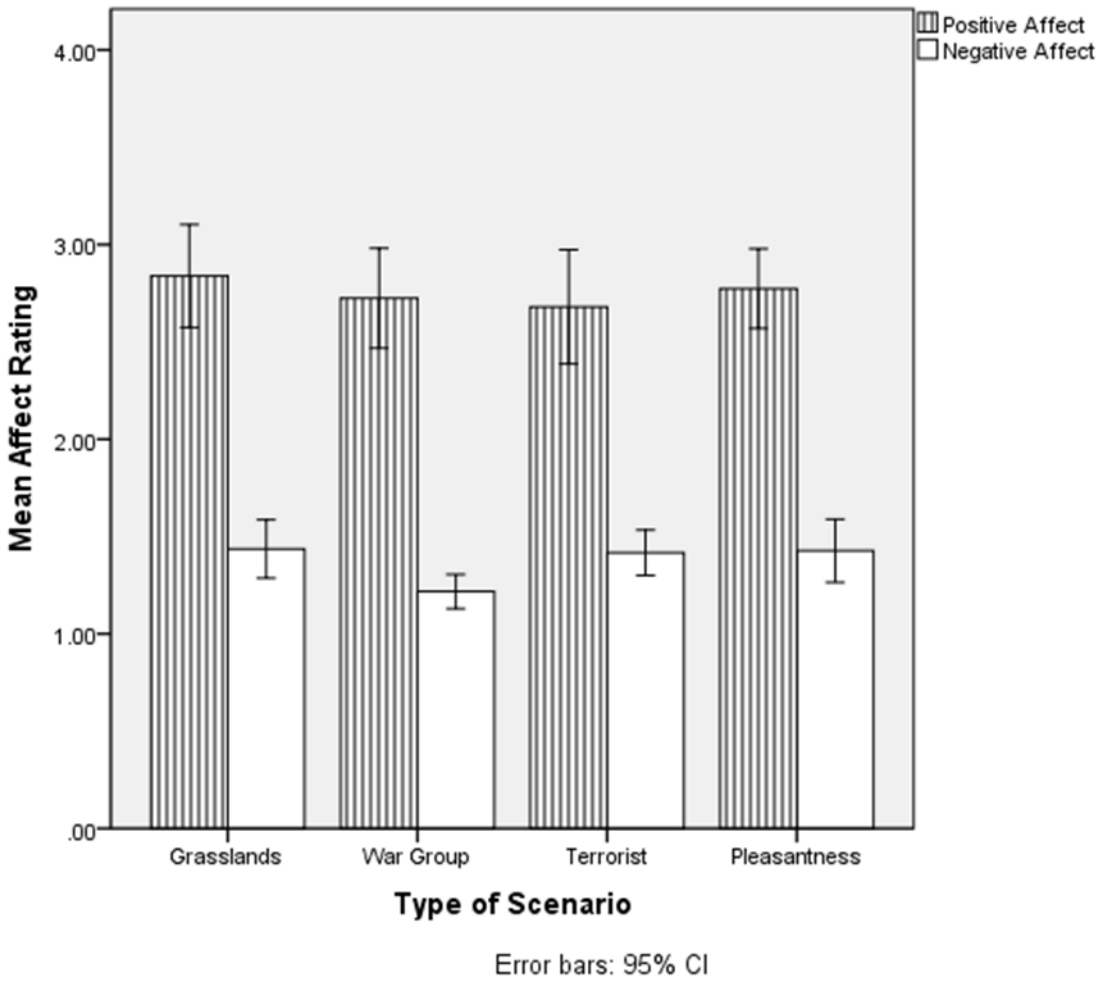

Figure 3. Mean value of positive and negative affect obtained from PANAS rating scores after being primed with the grasslands, war group, terrorist or pleasantness scenarios. Scale values ranged from 1 (not at all) to 5 (very much so).

Additionally, the level of positive and negative affect, across all four scenarios as reported in the PANAS test, is presented in Figure 3. Participants in the war group reported a slightly lower negative affect score than other groups, but there was little difference in positive affect across groups. A one-way between subjects ANOVA revealed no difference between ratings of subjects in any of the four scenarios, F (3, 116) = .30, p = .827 for the positive affect

and F (3, 116) = 2.52, p = .062 for the negative affect. Although the negative affect p value did not reveal significance, it was close enough to significance that its results were investigated further. LSD tests determined that the war group differed significantly from all of the other three groups, which did not differ from each other.

Table 1. Responses to questions asked on questionnaire in each of four scenarios.

	Type of Scenario							
	Grasslands		War Group		Terrorist		Pleasantness	
Question Asked	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	19.58	2.00	19.59	1.38	19.67	1.40	19.50	1.49
Percent Female	48.00	0.51	48.00	0.51	33.00	0.48	43.00	1.11
Fearful	2.29	1.24	2.69	1.41	3.23	1.16	N/A	N/A
Realistic	2.26	0.94	2.24	0.95	2.80	1.03	N/A	N/A
Relevant to Today	2.19	0.87	2.76	1.21	3.13	1.20	N/A	N/A
Imagine Death	2.33	1.35	2.41	1.35	2.57	1.33	N/A	N/A
Own Dying	1.90	1.24	1.79	1.08	2.63	1.30	N/A	N/A
Media	3.68	1.14	4.00	0.93	4.00	2.38	3.55	0.94
Arousal	2.57	1.36	2.17	1.07	2.57	1.30	2.26	1.24

In the follow-up questionnaire, participants were asked to rate the scenarios to the extent that they were fearful, realistic, relevant to today's society, and present in the media, as well as the degree to which they made the participants image death, think about the possibility of their own dying, or increase the amount of arousal felt. In Table 1, the results of the questions are

shown for the three survival scenarios. Ratings for pleasantness group are not included because that group was not given a scenario.

The ratings from the questions on the questionnaire were analyzed in relation to the three scenarios. Significant differences between the three scenarios were found for questions relating to whether the scenarios were fearful, realistic, relevant to today's society, and whether it brought about thoughts of one's own death as shown in Table 1.

Follow-up LSD tests revealed that the grasslands scenario was reported as less fearful and less realistic than the terrorist attack scenario. Additionally, the war scenario was rated as less realistic than the terrorist attack group. While the terrorist attack and war scenarios did not significantly differ in their reported relevance to today's society, both were reported as more relevant than the grasslands scenario. Lastly, the terrorist attack scenario led to significantly higher reports of thoughts of one's own death than both the war and grasslands scenarios.

Discussion

The present experiment tested whether or not the "survival processing effect" could be elicited in non-ancestral or modern scenarios, differing only in this regard from the traditional 'grasslands scenario' proposed by Nairne et al. The results of average total recall across scenarios support the hypothesis that non-ancestral scenarios can elicit as strong of a recall effect as the grasslands scenario. There is also slight evidence that the modern groups elicited higher recall than the grasslands scenarios, although not by a significant margin. Additionally, the participants regarded the two modern survival scenarios as more relevant to today's society on the questionnaire than the 'grassland scenario' which supports the choice of the specific scenarios.

Since the experiment conducted by Weinstein et al. (2008) had a similar hypothesis with contradicting results from the present study, it is essential to highlight the differences because they may offer an explanation. The 'modern' scenarios chosen in the present study were selected not solely for that purpose, but also due to their relevancy in the media and their potential for eliciting fear in participants. The city scenario in Weinstein et al.'s experiment could be interpreted in myriad ways by participants, and it is entirely possible that the participants' familiarity with a city environment would only make potential threats to survival in the city less threatening.

The 'war-zone' group and 'terrorist attack' group were chosen for their relevancy to modern threats, but also for their potential for eliciting an increase in fear and arousal. Since the majority of participants in the experiment are United States' citizens between the ages of 18 and 22, they have lived in a country engaged in war for the majority of their lives, a war brought about by a major terrorist attack. For this reason, both of these scenarios are believed to be very familiar for the participants and are thought to elicit fear above any other emotion. With the city scenario, it is possible that many participants associated the city with home, which would ease the fear associated with it.

Additionally, the topics for the two 'modern' scenarios in the present experiment have received heavy media attention for the past decade. In a 2011 study, both a 'zombie/grassland' and a 'zombie/city' scenario elicited higher recall than the traditional grassland and city scenarios (Soderstrom & McCabe, 2011). The authors attributed this finding, in part, to the level of fear and arousal associated with zombies, but also due to the media attention that the subject matter has garnered. The word zombie was chosen because when participants hear it, graphic images are instantly brought to mind. While the war group has the potential to elicit many

different images, it is much more concrete and readily associated with survival than a city. A terrorist attack readily brings about images of the September 11th terrorist attacks, particularly since Union College is located in New York State, and many participants have a strong attachment with New York City.

The location of Union College in relation to New York City may in part be responsible for the results of the ratings on the questionnaire. The 'terrorist attack' group was regarded as more fearful and more realistic, and was also found to elicit a higher degree of imagery of one's own death than the grassland group. While the 'war-zone' scenario was viewed as more fearful and was found to elicit more imagery of one's own death than the 'grasslands' scenarios, the difference was not significant. In order to tease apart this location effect, the study would need to be replicated in a location that had not suffered a recent terrorist attack.

The results of the PANAS task help to mitigate the possibility that participants experienced a change in mood after being read any of the scenarios. The only scenario that led to a reported change in mood was the 'war-zone' group in which participants reported lower ratings for negative affect words. While this may have important implications, the difference was slight and so it will be disregarded for the purposes of this discussion.

Additionally, the 'survival processing effect' was significantly more pronounced for the modern scenarios than the 'grasslands' scenario in the first minute of recall. It is possible that this finding is due to the familiarity of the modern scenarios over the ancestral scenario. Since participants were more familiar with the modern scenarios, they likely were able to form images related to the scenarios more quickly and were therefore able to access their memories associated with these images more quickly during recall. This familiarity may only serve to enhance recall

alongside the other factors at play, since familiarity was not enough to elicit the effect in previous studies.

All in all, the present study offers support for the notion that the survival processing effect can be elicited by scenarios that are non-ancestral, a finding which refutes the previously held belief that ancestral scenarios are critical. The most likely reason for this finding is that the modern scenarios utilized in this study were more realistic and fearful than non-ancestral scenarios previously utilized. While the present study offers additional insight concerning the robustness of the survival processing effect, additional studies are needed to provide insight regarding the mechanisms responsible for the effect.

Works Cited

Anderson, J.R., & Schooler, L.J. (1991). Reflections of the environment in memory. Psychological Science, 2, 396–408.

Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning & Verbal Behavior, 11,* 717-726.

Burns, D.J. & Herbert, T. (2005). Using cumulative-recall curves to assess the extent of relational and item-specific processing. *Memory,13 (2), 189-199.*

Hart, J., & Burns, D.J. (2012). Nothing concentrates the mind: Thoughts of death improve recall. *Psychonomic Bulletin Review, 19, 264-269.*

Fox, E., Griggs, L., & Mouchlianitis, E. (2007). The detection of fear-relevant stimuli: Are guns noticed as quickly as snakes? *Emotion, [7]: 4,* 691-696.

Burns, D.J., Burns, S.A., & Hwang, A.J. Adaptive memory: Determining the proximate mechanisms responsible for the memorial advantages of survival processing. *Journal of Experimental Psychology: Learning, Memory and Cognition, 37,* 206-218.

Kang, S.H.K., McDermott, K.B.,& Cohen, S.M. (2008). The mnemonic advantage of processing fitness-relevant information. *Memory & Cognition, 36,* 1151-1156.

Klein, S.B., Robertson, T.E., & Delton, A.W. (2010). Facing the future: Memory as an evolved system for planning future acts. *Memory & Cognition, 38,* 13-22.

LaBar, K. S. & Phelps, E. A. (1998). “Arousal-mediated memory consolidation: Role of the medial temporal lobe in humans”. *Psychological Science, 9,* 490–493

Nairne, J.S., & Pandeirada, J.N.S. (2008). Adaptive memory: Remembering with a stone-age brain. *Current Directions in Psychology, 17(4),* 239-243.

Nairne, J. S., Thompson, S. R., & Pandeirada, J. N. S. (2007). Adaptive memory: Survival processing enhances retention. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 33*, 263-273.

Rogers T.B., Kuiper N.A., & Kirker W.S. (1977). Self-reference and the encoding of personal information. *Journal of Personality and Social Psychology, 35*, 677-88.

Seligman, M. (1971). Phobias and preparedness. *Behavior Therapy*, 307–321.

Shohamy, D., & Adcock, R.A. (2010). Dopamine and adaptive memory. *Trends in Cognitive Sciences, 14*, 464-472.

Soderstom, N.C, & McCabe, D.P. (2011). Are survival processing memory advantages based on ancestral priorities? *Psychonomic Bulletin and Review., 18,* 564-569.

Weinstein, Y., Bugg, J.M., Roediger III, H.L., (2008). Can the survival recall advantage be explained by basic memory processes? *Memory & Cognition, 36*, 913-919.

Wise, R.A. (2004). Dopamine, learning and motivation. *Nature Reviews Neuroscience, 5*, 483-494.